OCR
Oxford Cambridge and RSA

An OCR endorsed teaching and learning tool

# OCR A Level Computer Science

## H446 – Paper 2

2

## Selection

Unit 11
Programming techniques

PG ONLINE

# Objectives

- Use relational operators
- Use Boolean operations AND, OR, NOT
- Use the switch/case statement for selection
- Use nested selection statements

# if .. then .. endif

- Program flow is controlled by evaluating a Boolean condition
- A Boolean condition evaluates to True or False
- If the condition is true then one or more statements are executed
  - if condition x is True then
  - execute statements 1, 2, 3...
  - endif
- If condition x is not true, statements 1, 2, 3.. are skipped and control passes to the next statement

# Relational operators

> greater than

< less than

=> greater than or equal to

=< less than or equal to

== equal to (= in some languages)

!= not equal to (<> in some languages)

*Operators vary according to programming languages*

# Complete the table:

| X | Y | condition | True or False? |
|---|---|---|---|
| 5 | 4 | X > Y | |
| 4 | 4 | X <= Y | |
| 10 | 11 | X >= Y | |
| 10 | 10 | X >= Y | |
| 8 | 9 | X != Y | |

# Complete the table:

| X | Y | condition | True or False? |
|---|---|---|---|
| 5 | 4 | X > Y | True |
| 4 | 4 | X <= Y | True |
| 10 | 11 | X >= Y | False |
| 10 | 10 | X >= Y | True |
| 8 | 9 | X != Y | True |

# if.. then.. endif

- In the example below print (“y is less than x”) would not be executed as the condition y < x is not true

```
x = 3
y = 4
if x < y then
   print(“x is less than y”)
endif

if y < x then
   print(“y is less than x”)
endif
```

# Complex Boolean expressions

- Boolean expressions can include AND, OR and NOT
- For example:

```
if (grade < 0) OR (grade > 100) then ...
```

| Operator | Description |
|---|---|
| AND | Returns TRUE if both conditions are true |
| OR | Returns TRUE if either of the conditions is true |
| NOT | A TRUE expression becomes FALSE and vice versa |

# Examples

```
if age > 12 AND height > 3 then
   print(“You can ride the roller
coaster”)
endif

if age <13 OR age > 19 then
   print(“You are not eligible for teen
discount”)
endif

if NOT ((age > 12) AND (height > 3)) then
   print(“You cannot ride the roller
coaster”)
endif
```

# True or false?

- Which of the following are true?

| X | Y | Z | Condition | True or False? |
|---|---|---|---|---|
| 3 | 4 | 5 | X > Y AND Z > Y | |
| 3 | 4 | 5 | X + 3 > Y OR X -2 <= Y | |
| 4 | 5 | 6 | (X <= Y AND Y==Z) OR (Z>X) | |
| 4 | 5 | 6 | (X <= Y) AND (Y==Z OR Z<X) | |
| 3 | 9 | 11 | Y mod X == 0 AND Z mod X == 2 | |
| 3 | 9 | 11 | NOT ((Z > X) AND (Z > Y)) | |

# Boolean expressions

- Answers

| X | Y | Z | Condition | True or False? |
|---|---|---|---|---|
| 3 | 4 | 5 | X > Y AND Z > Y | FALSE |
| 3 | 4 | 5 | X + 3 > Y OR X -2 <= Y | TRUE |
| 4 | 5 | 6 | (X <= Y AND Y==Z) OR (Z>X) | TRUE |
| 4 | 5 | 6 | (X <= Y) AND (Y==Z OR Z<X) | FALSE |
| 3 | 9 | 11 | Y mod X == 0 AND Z mod X == 2 | TRUE |
| 3 | 9 | 11 | NOT ((Z > X) AND (Z > Y)) | FALSE |

# if .. then .. else .. endif

- Often, alternative statements need to be executed if the given condition is not met
- The if .. then .. else .. endif statement provides
  this option

```
if condition c then
   statements a, b, c,..
else
   statements x, y, z,..
endif
```

# Example

- Which statement would be executed in each of the statements below?
  - X = 5, Y = 6, A = 9, B = 10

```
if X > Y OR A <= B
then
   print("Option 1")
else
   print("Option 2")
endif
```

```
if X > Y AND A <= B then
    print("Option 1")
else
    print("Option 2")
endif
```

# Worksheet 2

- Now work through the questions in **Task 1** on the worksheet

# if .. then .. elseif .. else .. endif

- Use multiple if ..then.. else if statements to evaluate more than one condition
- What would the output be for each of the following values?
  - age = 11, age = 12 and age = 13

```
if age < 12 then
   print(“Age is less than 12”)
elseif age = 12 then
   print(“Age is 12”)
else
   print(“Age is greater than 12”)
endif
```

# switch/case .. endswitch

- A switch/case statement is the logical equivalent of the if.. then.. else .. endif statement
  - It is used to make it easier to code multiple condition checks
  - Some languages (e.g. Python) do not have a switch/case statement

```
switch choice:
    case a:       print(“You chose a”)
    case b:       print(“You chose b”)
    case c:       print (“You chose c”)
    default:
                  print(“Invalid choice”)
```

# Sample problem

- Suppose you need to calculate grades from exam marks and print out the grade for each student
  - What grade boundaries would you select?
  - What input would you need?
  - What conditions would you evaluate?
  - What output statements would you need?

# Worksheet 2

- Now work through **Task 2** on the worksheet

# Nested if

- In the nested if statement, the second condition is only checked if the first condition is true:

```
if x then
   if y then
      print (“A”)
   else
      print (“B”)
   endif
else
   print (“C”)
endif
print (“D”)
```

# Nested if

- What will the output be if age is (i) 11 (ii) 12 (iii) 13

```
if age > 11 then
   if age > 12 then
      print (“Age Group 1”)
   else
      print (“Age Group 2”)
   endif
else
   print (“Age Group 3”)
endif
print (“This is the end of the
program”)
```

# Nested IF vs AND operator

- Compare these algorithms. What output would each produce with the following input:

  (i) age 10, height 1m  (ii) age 10, height .95m  (iii) age 9, height 1m

```
if age >= 10 AND height >= 1
then
    print("You can ride the
    rollercoaster.")
else if age>=10 AND height<1
then
    print("You are too short
    to ride.")
else if age < 10 then
    print("You are too young
    to ride.")
endif
```

```
if age >= 10 then
    if height >= 1 then
        print("You can ride
    the rollercoaster.")
    else
        print("You are too
short to ride.")
else
    print("You are too young
    to ride.")
endif
```

# Worksheet 2

- Now work through **Task 3** on the worksheet

# Plenary

- **if .. then .. else** statements can control program flow
  - relational operators can be used to compare values within the expression
  - Boolean operators **AND**, **OR** can be used to link multiple expressions
  - **elseif** (elif in Python) can be used to evaluate multiple expressions
  - **switch… endswitch** can be used to evaluate multiple expressions

## Copyright

© 2016 PG Online Limited

The contents of this unit are protected by copyright.

This unit and all the worksheets, PowerPoint presentations, teaching guides and other associated files distributed with it are supplied to you by PG Online Limited under licence and may be used and copied by you only in accordance with the terms of the licence. Except as expressly permitted by the licence, no part of the materials distributed with this unit may be used, reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic or otherwise, without the prior written permission of PG Online Limited.

## Licence agreement

This is a legal agreement between you, the end user, and PG Online Limited. This unit and all the worksheets, PowerPoint presentations, teaching guides and other associated files distributed with it is licensed, not sold, to you by PG Online Limited for use under the terms of the licence.

The materials distributed with this unit may be freely copied and used by members of a single institution on a single site only. You are not permitted to share in any way any of the materials or part of the materials with any third party, including users on another site or individuals who are members of a separate institution. You acknowledge that the materials must remain with you, the licencing institution, and no part of the materials may be transferred to another institution. You also agree not to procure, authorise, encourage, facilitate or enable any third party to reproduce these materials in whole or in part without the prior permission of PG Online Limited.